CLAIMS

1. An optical switching element comprising:

a polarizer adapted to receive electromagnetic energy incident thereon from at least two input paths, and to transmit electromagnetic energy along at least two output paths;

at least one phase shifter disposed within said at least two input paths; and

said at least one phase shifter being selectively actuatable to pass electromagnetic energy therethrough alternately with and without shifting the phase thereof.

2. The optical switching element of claim 1, wherein electromagnetic energy incident on said polarizer from any one of said at least two input paths is adapted for being transmitted along any one of said at least two output paths.

3. The optical switching element of claim 1, further comprising at least one phase shifter disposed in each of said at least two input paths, wherein a plurality of said at least one phase shifters are independently

actuatable relative to one another.

4. The optical switching element of claim 3, wherein each of said plurality of phase shifters is substantially planar and disposed orthogonally relative to the input path passing therethrough.

5. The optical switching element of claim 1, wherein said at least one phase shifter is disposed in spaced relation relative to said polarizer, so that said at least two output paths are free from said at least one phase shifter.

6. The optical switching element of claim 1, wherein said at least two input paths are mutually orthogonal, and said at least two output paths are mutually orthogonal.

7. The optical switching element of claim 5, wherein said polarizer is substantially planar and disposed at a 45 degree angle to each of said at least two input paths.

8. The optical switching element of claim 7, further comprising:

a solid being transparent to said electromagnetic energy;

said solid having four mutually orthogonal faces;

said planar polarizer disposed at a 45 degree angle to each of said four mutually orthogonal faces; and

at least one phase shifter being disposed on each of two adjacent ones of said four mutually orthogonal faces;

wherein said output paths pass through two adjacent other ones of said four mutually orthogonal faces.

9. The optical switching element of claim 1, further comprising a computer usable medium having a computer readable program code embodied therein for causing the computer to selectively actuate said at least one phase shifter, wherein said computer readable program code includes a routing algorithm.

10. An optical interconnect device for selectively interconnecting a plurality of electromagnetic signals between a plurality of inputs and a plurality of outputs, said optical interconnect device comprising:

a plurality of said optical switching elements of claim 1;

a plurality of all-optical signal paths extending between said plurality of inputs and said plurality of outputs, said plurality of all-optical signal paths including said at least two input paths and said at least two output paths.

11. The optical interconnect device of claim 10, being a solid state device.

12. The optical interconnect device of claim 10, wherein each of said plurality of all-optical signal paths has substantially the same pathlength.

13. The optical interconnect device of claim 10, wherein each of said plurality of all-optical signal paths has substantially the same latency.

14. The optical interconnect device of claim 10, wherein each of said plurality of all-optical signal paths are contention-free relative to one another.

15. The optical interconnect device of claim 14, wherein each of said plurality of all-optical signal paths are adapted to simultaneously maintain a plurality of electromagnetic

signals therein.

16. The optical interconnect device of claim 10, wherein each of said plurality of all-optical signal paths provides substantially the same signal attenuation relative to one another.

17. The optical interconnect device of claim 10, further comprising:

N inputs and N outputs;

said plurality of all-optical signal paths being contention-free and adapted to couple each of said N inputs to each of said N outputs, using $N(\log_2 N-1)$ of said optical switching elements.

18. The optical interconnect device of claim 10, wherein each one of said plurality of said optical switching elements further comprises:

a solid being transparent to said electromagnetic signals;

said solid having four mutually orthogonal faces;

said planar polarizer being disposed at a 45 degree angle to each of said four mutually

orthogonal faces;

at least one phase shifter being disposed on two adjacent ones of said four mutually orthogonal faces; and

each of said plurality of said optical switching elements being disposed in corner to corner relation to one another.

19. The optical interconnect device of claim 10, wherein said plurality of said optical switching elements each further comprise:

a solid being transparent to said electromagnetic signals;

said solid having four mutually orthogonal faces;

said planar polarizer being disposed at a 45 degree angle to each of said four mutually orthogonal faces;

at least one phase shifter being disposed on two adjacent ones of said four mutually orthogonal faces; and

each of said plurality of said optical switching elements being disposed in surface to surface relation to one another.

20. The optical interconnect device of claim 10, further comprising a 4x4 interconnect block having first, second,

third and fourth 2x2 optical switching elements;

wherein an output path of said first 2x2 switching element is coupled to an input path of said third 2x2 switching element, an other output path of said first 2x2 switching element is coupled to an input path of said fourth 2x2 switching element, an output path of said second 2x2 switching element is coupled to input of said third switching element, and an other output path of said second switching element is coupled to an input path of said fourth 2x2 switching element.

21. The optical interconnect device of claim 20, wherein said first, second, third and fourth 2x2 switching elements are disposed in surface to surface alignment with one another.

22. The optical interconnect device of claim 20, wherein said first, second, third and fourth 2x2 switching elements are disposed in corner to corner alignment with one another.

23. The optical interconnect device of claim 22, further

comprising a plurality of said 4x4 interconnect blocks.

24. The optical interconnect device of claim 20, wherein input paths of said first and second 2x2 switching elements comprise inputs of said 4x4 optical interconnect block and outputs of said third and fourth 2x2 switching element comprise outputs of said 4x4 interconnect block.

25. The optical interconnect device of claim 24, further comprising a plurality of said 4x4 interconnect blocks coupled to one another.

26. The optical interconnect device of claim 25, being fabricated as a unitary device.

27. The optical interconnect device of claim 26, further comprising a plurality of mirrors disposed therein.

28. The optical interconnect device of claim 25, further comprising an 8x8 device.

29. The optical interconnect device of claim 25, further comprising a 16x16 interconnect device.

30. The optical interconnect device of claim 25, wherein said 4x4 interconnect blocks are coupled to one another in a Beneš Network.

31. The optical interconnect device of claim 25, wherein said 4x4 interconnect blocks are coupled to one another in a PM2K Network.

32. The optical interconnect device of claim 25, wherein said 4x4 interconnect blocks are coupled to one another in a shuffle exchange architecture.

33. An optical interconnect device for selectively interconnecting a plurality of electromagnetic signals between a plurality of inputs and a plurality of outputs, said optical interconnect device comprising
a plurality of selectively actuatable optical switching elements and a plurality of all-optical signal paths extending through said plurality of selectively actuatable optical switching elements between the plurality of inputs and the plurality of outputs, wherein each of said plurality of all-optical signal paths has substantially the same pathlength.

34. The optical interconnect device of claim 33, further comprising a computer usable medium having a computer readable program code embodied therein for causing the computer to selectively actuate each of said plurality of selectively actuatable optical switching elements, wherein said computer readable program code includes a routing algorithm.

35. The optical interconnect device of claim 33, further comprising an NxN device, where N is the number of inputs and outputs.

36. An optical interconnect system comprising:
an optical interconnect device adapted for selectively interconnecting a plurality of electromagnetic signals between a plurality of inputs and a plurality of outputs, said optical interconnect device having a plurality of selectively actuatable optical switching elements and a plurality of all-optical signal paths extending through said plurality of optical switching elements between the plurality of inputs and the plurality of outputs, wherein each of said

plurality of all-optical signal paths has substantially the same pathlength; and

a computer usable program module having a computer readable program code embodied therein for causing the computer to selectively actuate each of said plurality of selectively actuatable optical switching elements.

37. The system of claim 36, further comprising a driver disposed in operative engagement with said program module and with said optical interconnect device for said selective actuation.

38. The interconnect system of Fig. 37, further comprising a controller operatively engaged with said program module and said driver for controlling said operative engagement of said program module with said driver.

39. A method for selectively interconnecting a plurality of electromagnetic signals between a plurality of inputs and a plurality of outputs, the method comprising the steps of:

(a) providing a polarizer adapted to receive the plurality of electromagnetic signals incident

thereon from at least two input paths, and to transmit the plurality of electromagnetic signals along at least two output paths;

(b) disposing at least one phase shifter within the at least two input paths, the at least one phase shifter being selectively actuatable to pass electromagnetic signals therethrough alternately with and without shifting the phase thereof; and

(c) selectively actuating the at least one phase shifter.